Streamlining Meter Data Analytics

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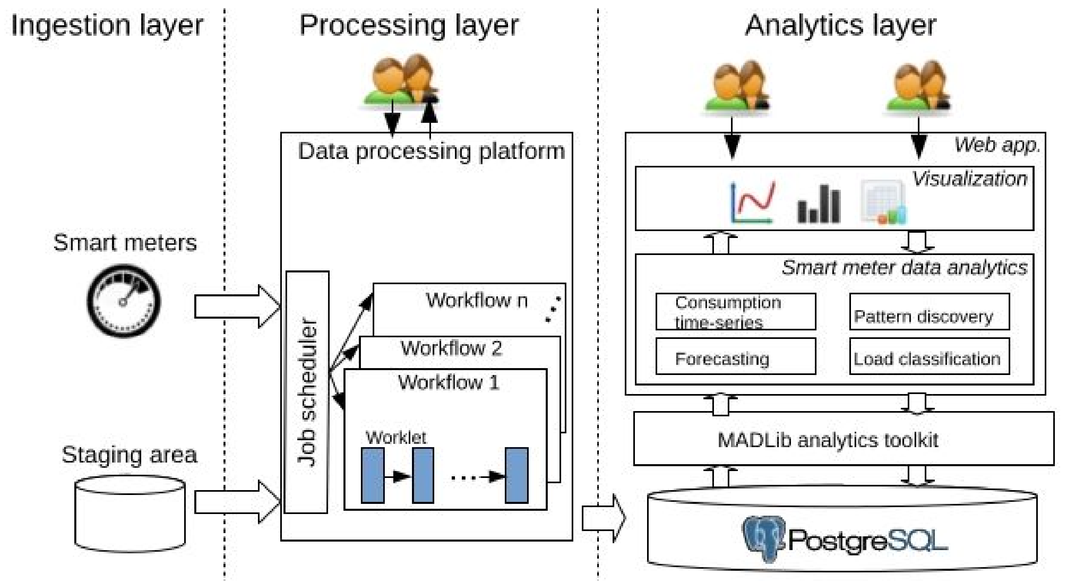
Smart Electricity Meters

- Record and communicate whole-house electricity consumption (e.g., hourly or every 15 minutes)
- Worldwide deployment expected to reach over 600 million meters in 2016 (according to Berg Insight)
- Hourly measurements enable time-of-use billing which can help reduce peak demand
- Smart meter analytics can lead to improved forecasting, money-saving tips for customers, etc.

System Architecture

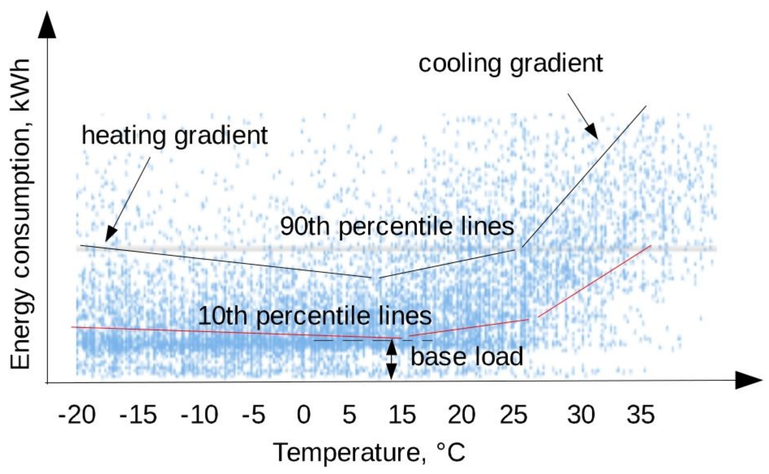


All algorithms implemented inside the database using PostgreSQL + MADLib

Smart Meter Analytics

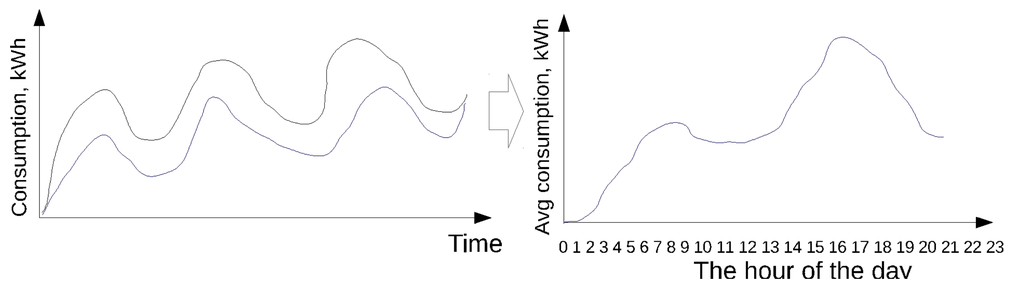
- Input: hourly whole-house smart meter time series and outdoor temperature
- Output:
  - For each customer: simple visualization, histograms, temperature sensitivity analysis, daily load shapes
  - Across customers: clustering, comparison with neighbourhood

Example 1: Temperature Sensitivity Analysis via Degree-Day Plots



- For climates with a summer and winter
- Step 1: fit piecewise regression lines for 10^{th}, 50^{th} and 90^{th} percentiles of hourly consumption as a function of temperature
- Step 2: obtain base load from 10^{th} percentile regression lines
- Step 3: obtain heating and cooling gradients from the 90^{th} percentile regression lines
- Step 4: obtain heating and cooling setpoints from the 90^{th} percentile regression lines

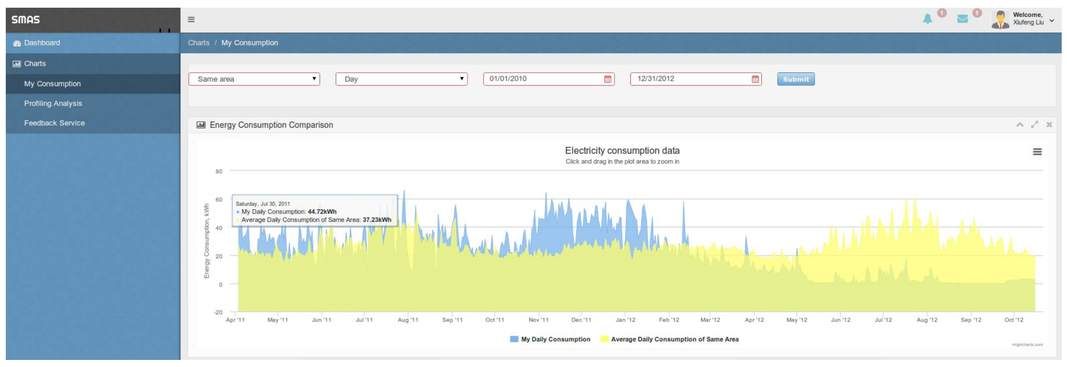
Example 2: Daily Load Shapes via Time Series Auto-Correlation



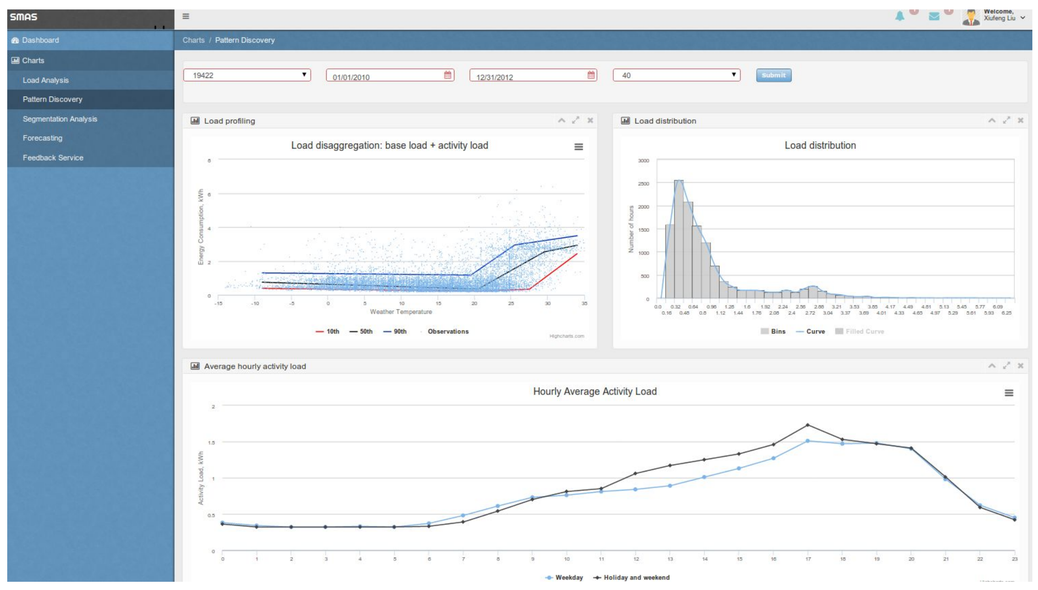
- Idea: take whole-house smart meter time series (black) and remove the effect of temperature via time-series autocorrelation with temperature as the exogenous variable (blue)
- Then plot the average consumption at each hour of the day

System Functionalities

- Customer Dashboard
  - Your consumption (blue) vs. neighbourhood average (yellow)
  - Personalized feedback



- Analyst Dashboard
  - Histograms, temperature sensitivity, daily load shapes for all customers
  - Clustering based on load shapes
  - Feedback rule engine



Acknowledgements

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For More Information

- Liu X, Nielsen P S. Streamlining smart meter data analytics. SDEWES2015.0558, 1-14, 2015
- Liu X, Nielsen P S. A Hybrid ICT-solution for smart meter data analytics. Journal of Energy, 2016.